

DOCUMENT RESUME

ED 244 968

TM 840 240

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TITLE The Effect of Anxiety and Boredom on Cognitive Test Performance.
INSTITUTION National Center for Education Statistics (ED), Washington, DC.
PUB DATE 24 Apr 84
NOTE 15p.; Paper presented at the Annual Meeting of the American Educational Research Association (68th, New Orleans, LA, April 23-27, 1984).
PUB TYPE Speeches/Conference Papers (150) -- Reports - Research/Technical (143)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Anxiety; *Cognitive Development; Cognitive Tests; High Schools; High School Seniors; *Performance Factors; *Scores; *Test Anxiety; *Testing Problems
IDENTIFIERS *Boredom; High School and Beyond (NCES)

ABSTRACT

Two factors which act to depress cognitive test performance are referred to as anxiety and boredom. The responses to a 20-item adjectival checklist administered to high school seniors after completing a cognitive test battery were subjected to iterative principal axes factor analysis. The relationships between anxiety or boredom and test performance were explored. Anxiety and boredom were shown to have adverse effects upon performance on reading and mathematics tests. Anxiety and, to a lesser extent, boredom sometimes appear to have effects on test performance which are strong enough to neutralize or reverse effects associated with other variables, such as sex, socioeconomic status, and race or ethnicity. Differences in anxiety level can lead to differences in test scores large enough to mask any evidence of growth. Cognitive growth may not be indicative of true growth, but reflects a change in anxiety level. (DWH)

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SESSION 16.05
PROBLEMS IN ASSESSING COGNITIVE GROWTH IN HIGH SCHOOL:
EVIDENCE FROM HIGH SCHOOL AND BEYOND

THE EFFECT OF ANXIETY AND BOREDOM ON
COGNITIVE TEST PERFORMANCE

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Paper presented at the 1984 Annual Meeting of the
American Educational Research Association
April 24, 1984

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THE EFFECT OF ANXIETY AND BOREDOM ON COGNITIVE TEST PERFORMANCE

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Since Mandler and Sarason's pioneer study of test anxiety, in 1952, a large research literature on this topic has developed. Numerous studies have shown that anxiety, as measured by a variety of instruments, generally has a deleterious effect upon test performance.

In 1967 Liebert and Morris introduced a two-component conceptualization of test anxiety; work and emotionality. Worry refers to cognitive concerns about how well one will do, etc. while emotionality refers to the subject's reported awareness of autonomic arousal, e.g. pounding heart. Many factor analytic studies have confirmed the two factors of worry and emotionality.

The study which I will report to you today also yields evidence of two factors which act to depress cognitive test performance. We have named these factors "anxiety" and "boredom". Our anxiety factor probably has much in common with Liebert and Morris's "worry" factor. As I will explain later, the design of our study was such that emotionality could not be measured.

So far as I am aware, boredom per se has not been previously identified as a factor influencing test performance although at an intuitive level it might be viewed as analogous to the effective component of test anxiety as conceived by a number of researchers.

Research Design

As most of you probably know, High School and Beyond is a large longitudinal study of high school sophomores and seniors which began with a base-year data collection in spring 1980. Over 30,000 sophomores and 28,000 seniors participated. They were selected so as to be nationally representative of the population of sophomores and seniors of that year. Questionnaires and cognitive tests were administered to all respondents.

Immediately after completing the cognitive test battery, the seniors were administered a short list of questions asking how they had felt while taking the tests, how important they judged them to be, how concerned they were about doing well, whether they enjoyed them, etc. The final question consisted of an adjectival check list of 20 items. Subjects checked yes or no to indicate whether they had felt calm, interested, afraid, bored, under a lot of pressure, uneasy, confident, etc.

Responses to these questions were subjected to an iterative principal axes factor analysis. Two factors were identified which we have named anxiety and boredom. The final PROMAX rotation of these factors indicated that they are highly orthogonal ($r = .05$). I might add that these factors had maintained their orthogonality through a variety of other rotational procedures which we tried.

The Anxiety Factor

The anxiety factor was derived from responses to questions about discomfort, tenseness, nervousness, difficulty in concentrating, etc. The nine items with high anxiety loadings can be viewed as an anxiety scale with a potential score range of 0 - 9.

By and large, the subjects participating in this study were rather low in anxiety. Forty-two percent had anxiety scores of zero. Only 10 percent had scores of 5 or higher. Obviously, the distribution of scores yielded by this scale is highly skewed.

It is interesting to see what kind of characteristics are associated with zero anxiety scores. We found that there was a significantly larger proportion of whites with zero scores than there was of blacks or Hispanics (44 percent vs. 30 and 32 percent). Zero scores were also more common among academic program students (48 percent) than among vocational program students (37 percent) or general program students (38 percent). Sex differences were not significant. Similarly, there were relatively fewer high anxious students (score of 5 or higher) among the academic program students than among the other two groups.

The Boredom Factor

The boredom factor was derived from responses indicating boredom, lack of concern for doing well on the tests, lack of enjoyment while taking the tests, etc. The eight items with high loadings on the boredom factor can be viewed as a boredom scale with a potential score range of 0-8.

Sixteen percent of the entire group got boredom scores of zero, and 19 percent got scores of "1". It seems likely that these students actually enjoyed taking the tests. At the high end of the scale, only .1 percent got scores of 7 or 8 which would indicate extreme boredom. Overall, the distribution of scores was relatively flat but with a slight skew to the right (high end of the scale).

If we classify as high in boredom all students who scored 5 or higher on the boredom scale, some interesting group differences are found. High boredom scores were more common among males than among females (21 vs. 14 percent); among whites than among blacks or Hispanics (18 vs. 12 and 14 percent), among high SES students than among low SES students (18 vs. 15 percent), and among vocational students than among academic program students (18 vs. 16 percent).

We must acknowledge that both the anxiety scale and the boredom scale are relatively crude instruments. Nevertheless, it seems safe to say that the general level of anxiety and boredom among our students was not high.

The Relationship between Anxiety and Test Performance

Here we examine the relationships between anxiety scores and performance on two of the cognitive tests: mathematics and reading. The mathematics test consisted of 25 multiple choice items and the reading test of 20 multiple choice items. In the analyses described below, we used formula scores, i.e. scores which were corrected for guessing.

Each student was assigned to one of four categories on the basis of anxiety score. Those with a score of zero were labeled "nonanxious"; those with a score of "1" were labeled "low anxious"; those with a score of 2-4 were labeled "medium anxious"; and those with a score of 5 or higher were labeled "high anxious". The percentages falling into these four categories were: 42, 24, 24, and 10.

Mean scores earned on the reading test and on the mathematics test by each of these subsets of students are shown in table 1.

Table 1.--Mean scores on the reading test and the mathematics test as related to anxiety level

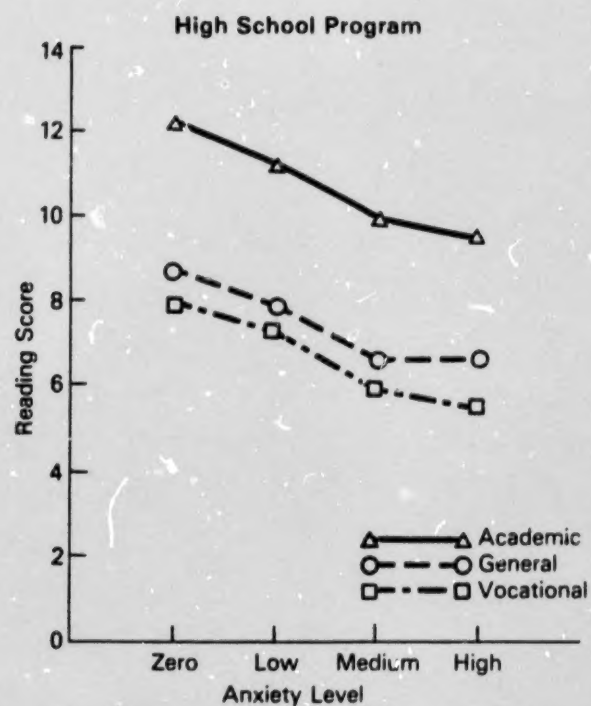
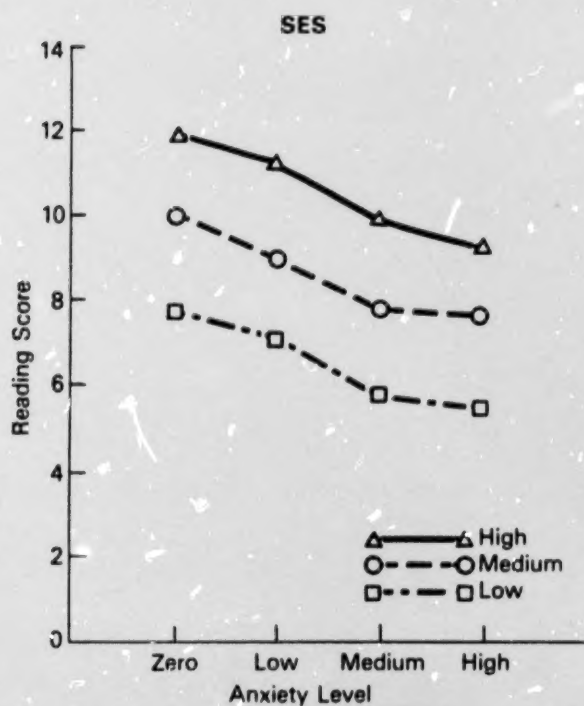
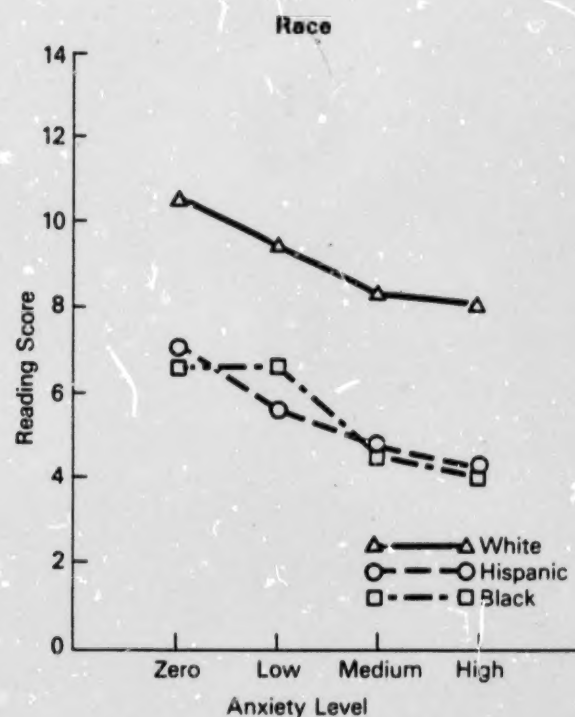
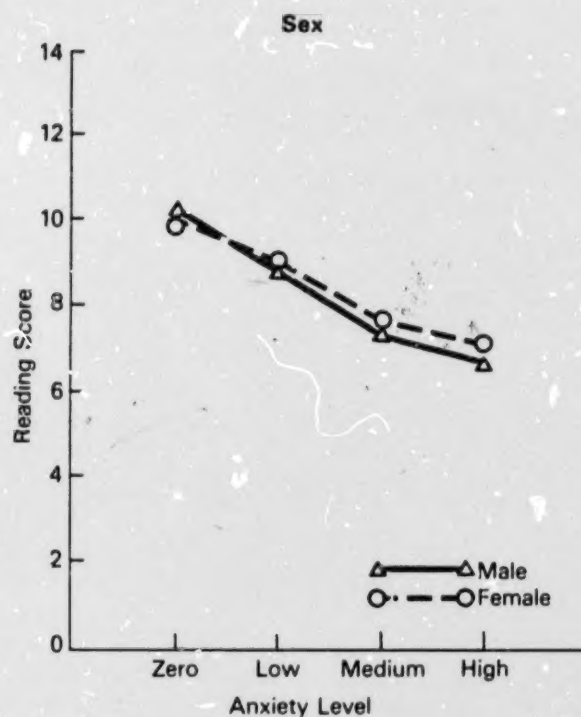
Anxiety level	Percentage of cases	Mean score on:	
		Reading	Mathematics
High	10	7.0	10.0
Medium	24	7.5	11.0
Low	24	9.0	13.0
Zero	42	10.1	14.2

It is clear with respect to both the reading and the mathematics test that test scores systematically decline with increases in test anxiety. All of these declines are statistically significant.

Figure 1 graphically portrays these relationships for the reading test, as moderated by the background variables of sex, race, socioeconomic status (SES) and high school program. For each of these moderator variables, the general pattern shows declining test scores associated with increases in anxiety level. With respect to each curve shown in Figure 1, the reading score of the high anxious students is significantly lower than that of the zero anxious students. Comparisons of intermediate points on the curves are often not significant.

Sex differences are not significant. Hispanics and blacks scored about the same but significantly lower than the whites. Note the clean separation of the curves of the different SES levels. It is also interesting to observe that the

Figure 1. Mean reading scores, as related to test anxiety level, by sex, race, SES, and high school program: seniors 1980



low SES students who had a zero anxiety level scored about the same as the medium SES students who had a medium or high anxiety level.

With respect to high school program, the three curves differ significantly at each of the four levels of anxiety. The higher performance level of the academic program students is readily apparent. The zero anxious vocational students actually scored as well or better than those general program students who had relatively high anxiety levels.

An analogous set of curves with respect to the mathematics test is shown in Figure 2. They are quite similar to the curves for reading that we have just considered. The only noteworthy dissimilarity is in the curves for sex. At each anxiety level except high, the mean mathematics score of the males was significantly higher than that of the females. It is interesting to note that females who had zero anxiety scores actually scored higher than did the males who had medium or high anxiety scores.

The Relationship between Boredom and Test Performance

Each student was assigned to one of three categories on the basis of boredom score. Scores of zero or 1 were considered "low"; between 2 and 4, medium; and scores of 5 or higher were considered "high". Percentages falling into these three categories were 36, 47, and 17.

Mean scores on the reading test and on the mathematics test for each of these subsets of students are shown in table 2.

Figure 2. Mean mathematics scores as related to test anxiety level, by sex, race, SES, and high school program: seniors, 1980

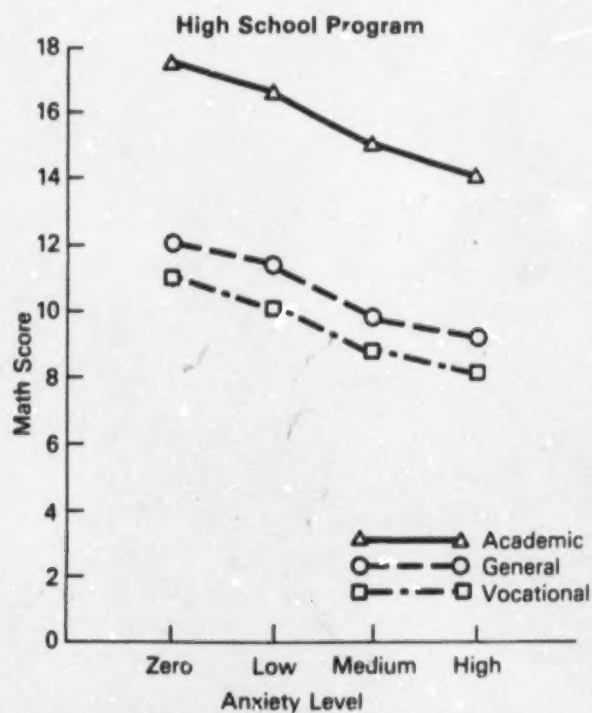
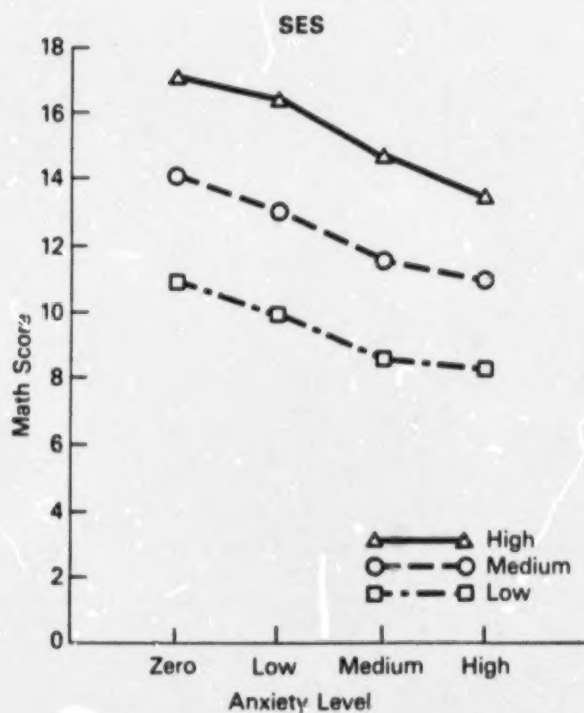
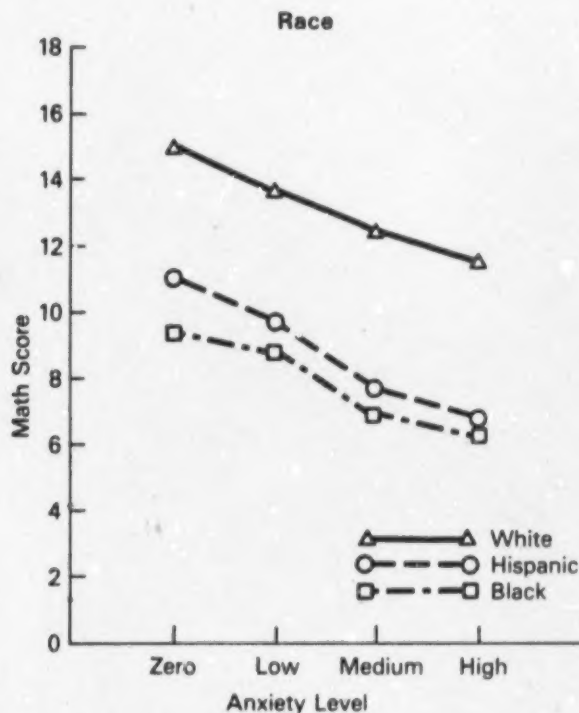
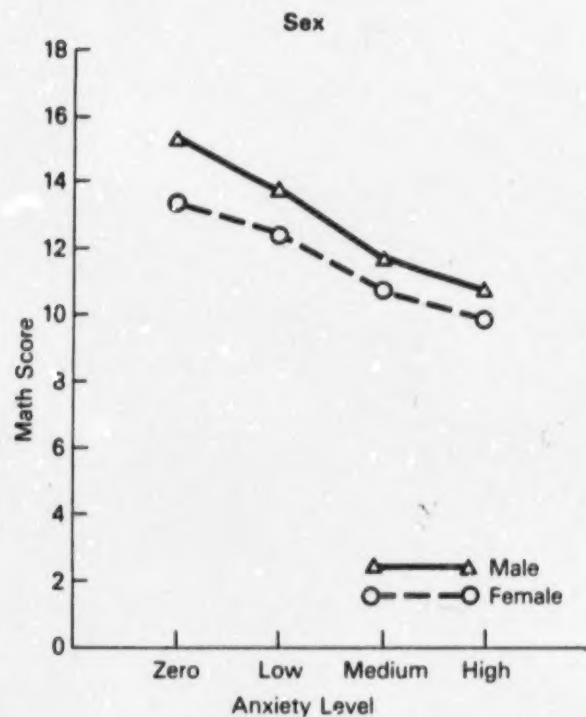


Table 2.--Mean scores on the reading test and the mathematics test as related to boredom level

Boredom level	Percentage of cases	Mean score on:	
		Reading	Mathematics
High	17	8.3	12.2
Medium	47	8.8	12.7
Low	36	9.4	13.3

Again we see that scores on both the reading and the mathematics test consistently decline with increasing levels of boredom. Admittedly the differences are small, and are less impressive than those found with respect to anxiety level.

Figure 3 shows the relationships between boredom level and reading test score, as moderated by sex, race, SES, and high school program. Sex differences are negligible although for both sexes, scores consistently decline with increasing boredom. This same trend is clearly evident for white students but not for blacks or Hispanics. Why this should be so is not clear.

For the other two moderator variables, SES and high school program, the general appearance of the trend curves is rather similar to that of the curves just considered. In all cases, the reading score of the high boredom group is significantly lower than that of the low boredom group. The general character of figure 3 suggests that SES was a more potent factor than boredom in affecting reading scores.

Parenthetically, I might mention that we are well aware of the fact that correlation does not prove causation. It could be argued that anxiety does not

Figure 3. Mean reading scores as related to boredom level, by sex, race, SES, and high school program: seniors, 1980

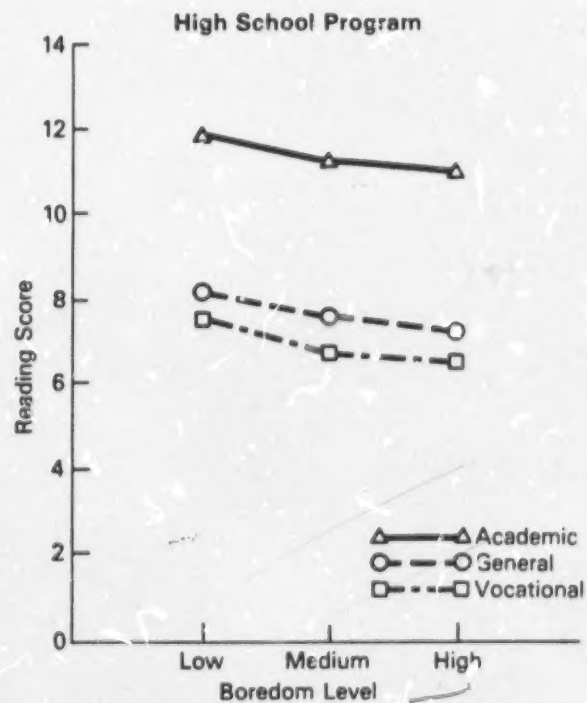
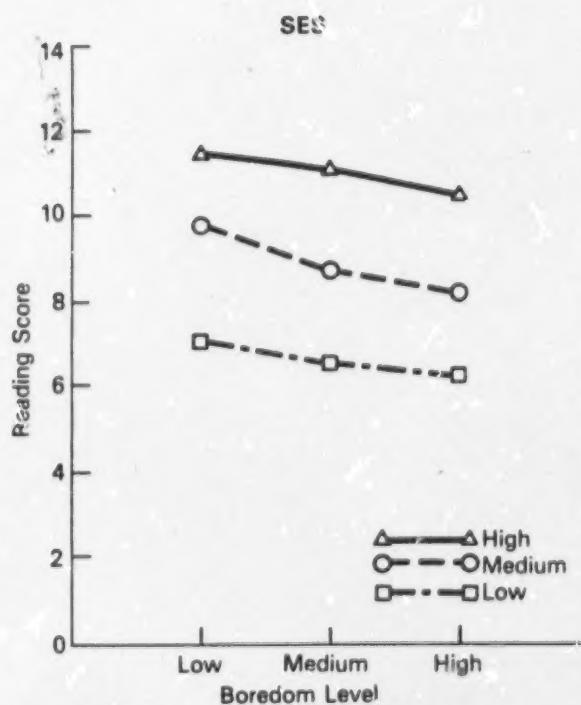
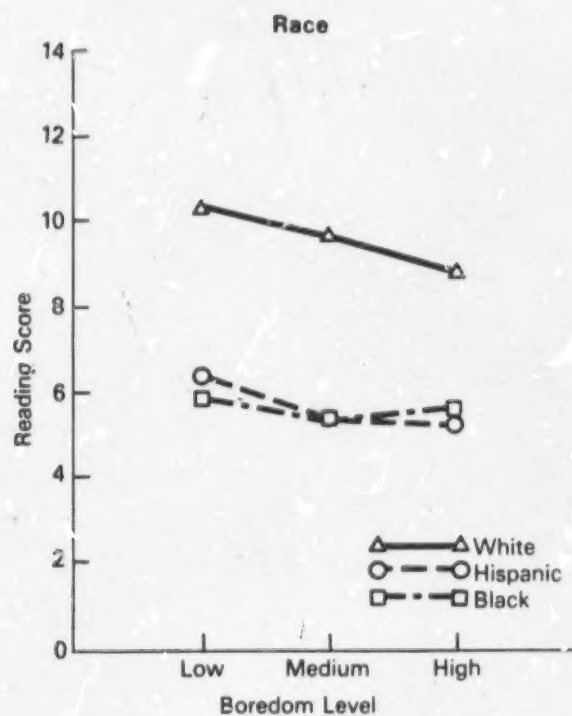
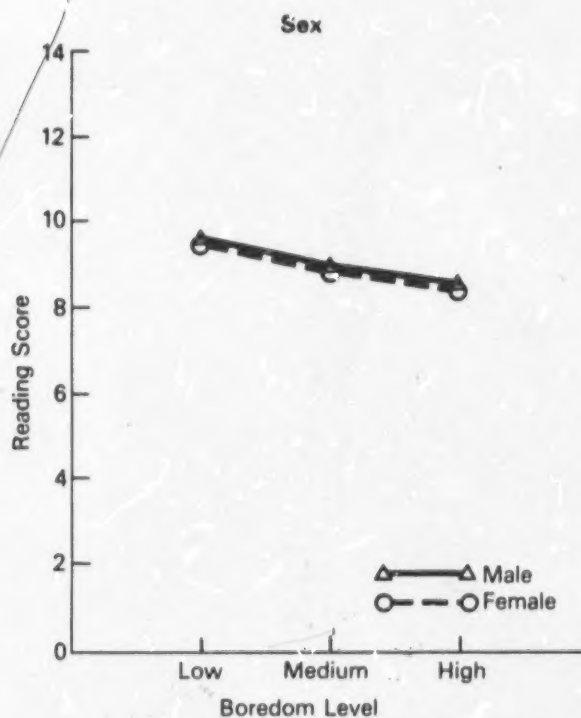
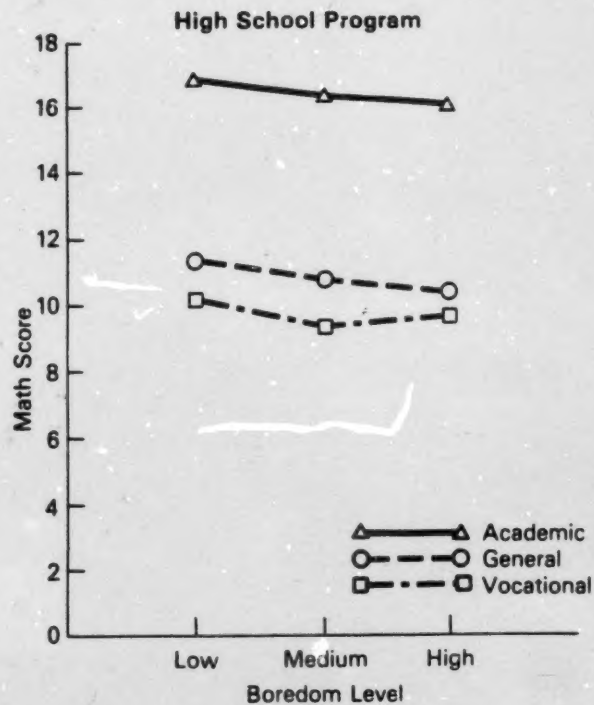
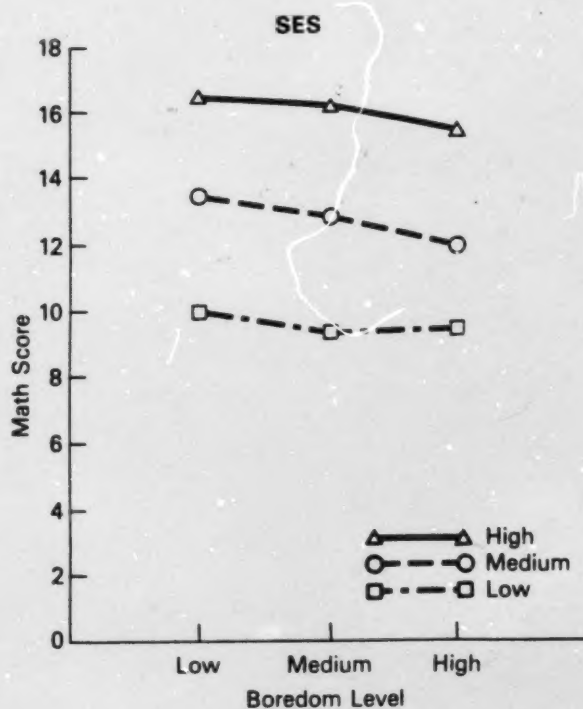
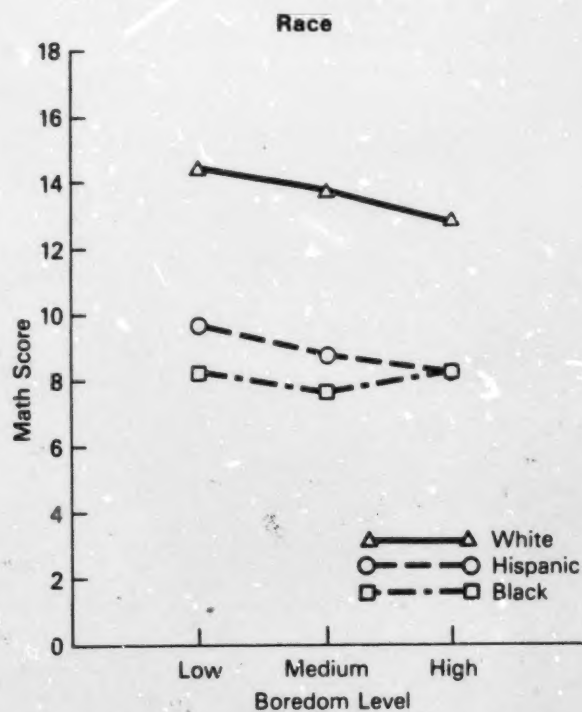
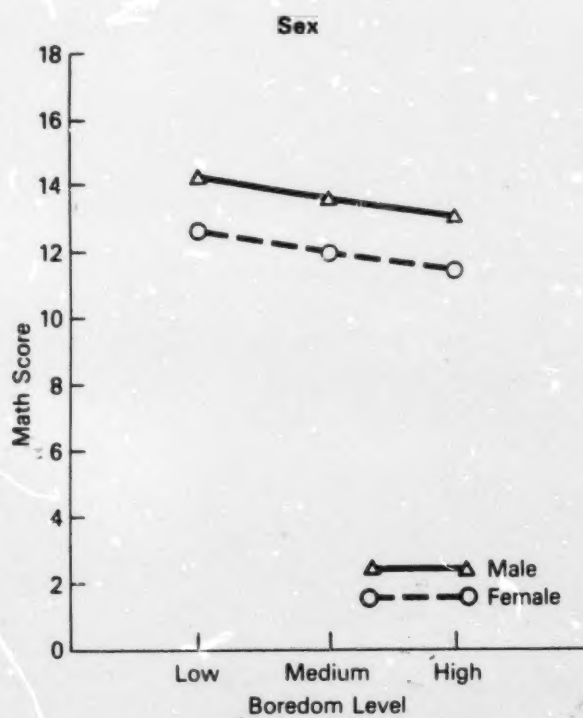


Figure 4. Mean mathematics scores as related to boredom level, by sex, race, SES, and high school program: seniors, 1980



depress reading scores but rather that poor readers know that they will score poorly on the reading test and become anxious because of that awareness.

Nevertheless, to simplify exposition, we shall continue to speak as if anxiety and boredom are causative factors.

A set of curves showing the relationship between boredom level and mathematics scores is shown in figure 4. These curves are quite similar to those for reading. In general, scores tend to decrease with increases in boredom although exceptions to this generalization are found with respect to: highly bored blacks, highly bored low SES students, and highly bored vocational education students.

Summary

Using very short scales for measuring anxiety and boredom, we have demonstrated that both those variables have adverse effects upon performance on a reading and a mathematics test. This effect of anxiety on test performance has, of course been found many times before. So far as we are aware, however, this is the first time that boredom has been shown to have a significant effect on cognitive test performance.

Probably the most interesting finding from this study is that anxiety, and to a lesser extent, boredom sometimes appear to have effects on test performance which are strong enough to neutralize or even reverse the effects associated with the variables of sex, SES, and race/ethnicity. It is conceivable that many of these time-honored relationships would undergo considerable change if test anxiety could be completely eliminated.

More relevant to this symposium topic is the point that differences in anxiety level can lead to differences in test scores which are large enough to completely mask any evidence of growth. A statistic which appears to indicate cognitive growth (or no growth) could conceivably indicate neither but rather a change in anxiety level.

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